UGANDA NATIONAL EXAMINATIONS BOARD

SECOND EDITION

FOUR-FIGURE

MATHEMATICAL, STATISTICAL TABLES AND MATHEMATICAL FORMULAE

NATURAL LOGARITHMS In x or $\log_e x$

x	0	1	2	3	4	5	6	7	8	9	ADD 1	2	3	4	5	6	7	8	9
1.0	0.0000	0100	0198								10	20	30	40	49	59	69	79	89
				0296	0392	0488	0583				10	19	29	38	48	57	67	76	86
								0677	0770	0862	9	18	28	37	46	55	64	74	83
1.1	0.0953	1044	1133								9	18	27	36	45	53	62	71	80
				1222	1310	1398	1484				9	17	26	35	44	52	61	70	78
								1570	1655	1740	8	17	25	34	42	50	59	67	76
1.2	0.1823	1906	1989								8	16	25	33	41	49	57	66	74
				2070	2151	2231	2311				8	16	24	32	40	48	56	64	72
								2390	2469	2546	8	16	23	31	39	47	55	62	70
1.3	0.2624	2700	2776	2852	2927						8	15	23	30	38	45	53	60	68
						3001	3075	3148	3221	3293	7	15	22	29	36	44	51	58	66
1.4	0.3365	3436	3507	3577	3646						7	14	21	28	35	42	49	56	63
						3716	3784	3853	3920	3988	7	14	20	27	34	41	48	54	61
1.5	0.4055	4121	4187	4253	4318						7	13	20	26	33	40	46	53	59
						4383	4447	4511	4574	4637	6	13	19	25	32	38	44	50	57
1.6	0.4700	4762	4824	4886	4947						6	12	19	25	31	37	43	50	56
						5008	5068	5128	5188	5247	6	12	18	24	30	36	42	48	54
1.7	0.5306	5365	5423	5481	5539						6	12	17	23	29	35	41	46	52
						5596	5653	5710	5766	5822	6	11	17	22	28	34	39	45	50
1.8	0.5878	5933	5988	6043	6098	6152	6206	6259	6313	6366	5	11	16	22	27	32	38	43	49
1.9	0.6419	6471	6523	6575	6627	6678	6729	6780	6831	6881	5	10	15	20	26	31	36	41	46
2.0	0.6931	6981	7031	7080	7129						5	10	15	20	25	29	34	39	44
						7178	7227	7275	7324	7372	5	10	14	19	24	29	34	38	43
2.1	0.7419	7467	7514	7561	7608	7655	7701	7747	7793	7839	5	9	14	19	23	28	33	38	42
2.2	0.7885	7930	7975	8020	8065	8109	8154	8198	8242	8286	4	9	13	18	22	26	31	35	40
2.3	0.8329	8372	8416	8459	8502	8544	8587	8629	8671	8713	4	9	13	17	21	26	30	34	39
2.4	0.8755	8796	8838	8879	8920	8961	9002	9042	9083	9123	4	8	12	16	20	25	29	33	37
2.5	0.9163	9203	9243	9282	9322	9361	9400	9439	9478	9517	4	8	12	16	20	23	27	31	35
2.6	0.9555	9594	9632	9670	9708	9746	9783	9821	9858	9895	4	8	11	15	19	23	27	30	34
2.7	0.9933	9969	**1.0006**	**0043**	**0080**	**0116**	**0152**	**0188**	**0225**	**0260**	4	7	11	14	18	22	25	29	32
2.8	1.0296	0332	0367	0403	0438	0473	0508	0543	0578	0613	4	7	11	14	18	21	25	28	32
2.9	1.0647	0682	0716	0750	0784	0818	0852	0886	0919	0953	3	7	10	14	17	20	24	27	31
3.0	1.0986	1019	1053	1086	1119	1151	1184	1217	1249	1282	3	7	10	13	16	20	23	26	30
3.1	1.1314	1346	1378	1410	1442	1474	1506	1537	1569	1600	3	6	10	13	16	19	22	26	29
3.2	1.1632	1663	1694	1725	1756	1787	1817	1848	1878	1909	3	6	9	12	15	19	22	25	28
3.3	1.1939	1969	2000	2030	2060	2090	2119	2149	2179	2208	3	6	9	12	15	18	21	24	27
3.4	1.2238	2267	2296	2326	2355	2384	2413	2442	2470	2499	3	6	9	12	15	17	20	23	26
3.5	1.2528	2556	2585	2613	2641	2669	2698	2726	2754	2782	3	6	8	11	14	17	20	22	25
3.6	1.2809	2837	2865	2892	2920	2947	2975	3002	3029	3056	3	5	8	11	14	16	19	22	24
3.7	1.3083	3110	3137	3164	3191	3218	3244	3271	3297	3324	3	5	8	11	13	16	19	22	24
3.8	1.3350	3376	3403	3429	3455	3481	3507	3533	3558	3584	3	5	8	10	13	16	18	21	23
3.9	1.3610	3635	3661	3686	3712	3737	3762	3788	3813	3838	3	5	8	10	13	15	18	20	23
4.0	1.3863	3888	3913	3938	3962	3987	4012	4036	4061	4085	2	5	7	10	12	15	17	20	22
4.1	1.4110	4134	4159	4183	4207	4231	4255	4279	4303	4327	2	5	7	10	12	14	17	19	22
4.2	1.4351	4375	4398	4422	4446	4469	4493	4516	4540	4563	2	5	7	10	12	14	17	19	22
4.3	1.4586	4609	4633	4656	4679	4702	4725	4748	4770	4793	2	5	7	9	12	14	16	18	21
4.4	1.4816	4839	4861	4884	4907	4929	4951	4974	4996	5019	2	4	7	9	11	13	15	18	20
4.5	1.5041	5063	5085	5107	5129	5151	5173	5195	5217	5239	2	4	7	9	11	13	15	18	20
4.6	1.5261	5282	5304	5326	5347	5369	5390	5412	5433	5454	2	4	7	9	11	13	15	18	20
4.7	1.5476	5497	5518	5539	5560	5581	5602	5623	5644	5665	2	4	6	8	11	13	15	17	19
4.8	1.5686	5707	5728	5748	5769	5790	5810	5831	5851	5872	2	4	6	8	10	13	15	17	19
4.9	1.5892	5913	5933	5953	5974	5994	6014	6034	6054	6074	2	4	6	8	10	12	14	16	18

If $x = y \times 10^{-n}$ with $1 \le y < 10$: $\ln x = \ln y + \ln 10^{-n} \equiv \ln y - 2.30259n$

If $x = y \times 10^{-n}$ with $1 \le y < 10$: $\ln x = \ln y + \ln 10^{-n} \equiv \ln y + 2.30259n$

NATURAL LOGARITHMS

$\ln x$ or $\log_e x$

x	0	1	2	3	4	5	6	7	8	9	ADD 1	2	3	4	5	6	7	8	9
5.0	1.6094	6114	6134	6154	6174	6194	6214	6233	6253	6273	2	4	6	8	10	12	14	16	18
5.1	1.6292	6312	6332	6351	6371	6390	6409	6429	6448	6467	2	4	6	8	10	12	14	16	18
5.2	1.6487	6506	6525	6544	6563	6582	6601	6620	6639	6658	2	4	6	8	10	11	13	15	17
5.3	1.6677	6696	6715	6734	6752	6771	6790	6808	6827	6845	2	4	6	8	9	11	13	15	17
5.4	1.6864	6882	6901	6919	6938	6956	6974	6993	7011	7029	2	4	5	7	9	11	13	14	16
5.5	1.7047	7066	7084	7102	7120	7138	7156	7174	7192	7210	2	4	5	7	9	11	13	14	16
5.6	1.7228	7246	7263	7281	7299	7317	7334	7352	7370	7387	2	4	5	7	9	11	13	14	16
5.7	1.7405	7422	7440	7457	7475	7492	7509	7527	7544	7561	2	3	5	7	9	10	12	14	15
5.8	1.7579	7596	7613	7630	7647	7664	7681	7699	7716	7733	2	3	5	7	9	10	12	14	15
5.9	1.7750	7766	7783	7800	7817	7834	7851	7867	7884	7901	2	3	5	7	8	10	12	14	15
6.0	1.7918	7934	7951	7967	7984	8001	8017	8034	8050	8066	2	3	5	6	8	10	11	13	14
6.1	1.8083	8099	8116	8132	8148	8165	8181	8197	8213	8229	2	3	5	6	8	10	11	13	14
6.2	1.8245	8262	8278	8294	8310	8326	8342	8358	8374	8390	2	3	5	6	8	10	11	13	14
6.3	1.8405	8421	8437	8453	8469	8485	8500	8516	8532	8547	2	3	5	6	8	10	11	13	14
6.4	1.8563	8579	8594	8610	8625	8641	8656	8672	8687	8703	2	3	5	6	8	10	11	13	14
6.5	1.8718	8733	8749	8764	8779	8795	8810	8825	8840	8856	2	3	5	6	8	9	11	12	14
6.6	1.8871	8886	8901	8916	8931	8946	8961	8976	8991	9006	2	3	5	6	8	9	11	12	14
6.7	1.9021	9036	9051	9066	9081	9095	9110	9125	9140	9155	1	3	4	6	7	9	10	12	13
6.8	1.9169	9184	9199	9213	9228	9242	9257	9272	9286	9301	1	3	4	6	7	9	10	12	13
6.9	1.9315	9330	9344	9359	9373	9387	9402	9416	9430	9445	1	3	4	6	7	8	10	11	13
7.0	1.9459	9473	9488	9502	9516	9530	9544	9559	9573	9587	1	3	4	6	7	8	10	11	13
7.1	1.9601	9615	9629	9643	9657	9671	9685	9699	9713	9727	1	3	4	6	7	8	10	11	13
7.2	1.9741	9755	9769	9782	9796	9810	9824	9838	9851	9865	1	3	4	6	7	8	10	11	13
7.3	1.9879	9892	9906	9920	9933	9947	9961	9974	9988	**2.0001**	1	3	4	6	7	8	10	11	13
7.4	2.0015	0028	0042	0055	0069	0082	0096	0109	0122	0136	1	3	4	5	7	8	9	10	12
7.5	2.0149	0162	0176	0189	0202	0215	0229	0242	0255	0268	1	3	4	5	7	8	9	10	12
7.6	2.0281	0295	0308	0321	0334	0347	0360	0373	0386	0399	1	3	4	5	7	8	9	10	12
7.7	2.0412	0425	0438	0451	0464	0477	0490	0503	0516	0528	1	3	4	5	6	8	9	10	12
7.8	2.0541	0554	0567	0580	0592	0605	0618	0631	0643	0656	1	3	4	5	6	8	9	10	12
7.9	2.0669	0681	0694	0707	0719	0732	0744	0757	0769	0782	1	2	4	5	6	7	8	10	11
8.0	2.0794	0807	0819	0832	0844	0857	0869	0882	0894	0906	1	2	4	5	6	7	8	10	11
8.1	2.0919	0931	0943	0956	0968	0980	0992	1005	1017	1029	1	2	4	5	6	7	8	10	11
8.2	2.1041	1054	1066	1078	1090	1102	1114	1126	1138	1150	1	2	4	5	6	7	8	10	11
8.3	2.1163	1175	1187	1199	1211	1223	1235	1247	1258	1270	1	2	4	5	6	7	8	10	11
8.4	2.1282	1294	1306	1318	1330	1342	1353	1365	1377	1389	1	2	4	5	6	7	8	10	11
8.5	2.1401	1412	1424	1436	1448	1459	1471	1483	1494	1506	1	2	4	5	6	7	8	10	11
8.6	2.1518	1529	1541	1552	1564	1576	1587	1599	1610	1622	1	2	4	5	6	7	8	10	11
8.7	2.1633	1645	1656	1668	1679	1691	1702	1713	1725	1736	1	2	4	5	6	7	8	10	11
8.8	2.1748	1759	1770	1782	1793	1804	1815	1827	1838	1849	1	2	3	4	6	7	8	9	10
8.9	2.1861	1872	1883	1894	1905	1917	1928	1939	1950	1961	1	2	3	4	6	7	8	9	10
9.0	2.1972	1983	1994	2006	2017	2028	2039	2050	2061	2072	1	2	3	4	6	7	8	9	10
9.1	2.2083	2094	2105	2116	2127	2138	2148	2159	2170	2181	1	2	3	4	5	7	8	9	10
9.2	2.2192	2203	2214	2225	2235	2246	2257	2268	2279	2289	1	2	3	4	5	7	8	9	10
9.3	2.2300	2311	2322	2332	2343	2354	2364	2375	2386	2396	1	2	3	4	5	7	8	9	10
9.4	2.2407	2418	2428	2439	2450	2460	2471	2481	2492	2502	1	2	3	4	5	7	8	9	10
9.5	2.2513	2523	2534	2544	2555	2565	2576	2586	2597	2607	1	2	3	4	5	6	7	8	9
9.6	2.2618	2628	2638	2649	2659	2670	2680	2690	2701	2711	1	2	3	4	5	6	7	8	9
9.7	2.2721	2732	2742	2752	2762	2773	2783	2793	2803	2814	1	2	3	4	5	6	7	8	9
9.8	2.2824	2834	2844	2854	2865	2875	2885	2895	2905	2915	1	2	3	4	5	6	7	8	9
9.9	2.2925	2935	2946	2956	2966	2976	2986	2996	3006	3016	1	2	3	4	5	6	7	8	9

n	1	2	3	4	5	6	7	8	9	10
$\ln 10^n$	2.3026	4.6052	6.9078	9.2103	11.5129	13.8155	16.1181	18.4207	20.7233	23.0259
$\ln 10^{-n}$	$\bar{3}.6974$	$\bar{5}.3948$	$\bar{7}.0922$	$\bar{10}.7897$	$\bar{12}.4871$	$\bar{14}.1845$	$\bar{17}.8819$	$\bar{19}.5793$	$\bar{21}.2767$	$\bar{24}.9741$

FACTORIALS AND LOGARITHMS OF FACTORIALS

n	$n!$	$\log n!$	n	$\log n!$	n	$\log n!$	n	$\log n!$
1	1	0.0000	26	26.6056	51	66.1906	76	111.2754
2	2	0.3010	27	28.0370	52	67.9066	77	113.1619
3	6	0.7782	28	29.4841	53	69.6309	78	115.0540
4	24	1.3802	29	30.9465	54	71.3633	79	116.9516
5	120	2.0792	30	32.4237	55	73.1037	80	118.8547
6	720	2.8573	31	33.9150	56	74.8519	81	120.7632
7	5040	3.7024	32	35.4202	57	76.6077	82	122.6770
8	40320	4.6055	33	36.9387	58	78.3712	83	124.5961
9	362880	5.5598	34	38.4702	59	80.1420	84	126.5204
10	3628800	6.5598	35	40.0142	60	81.9202	85	128.4498
11	3.992×10^7	7.6012	36	41.5705	61	83.7055	86	130.3843
12	4.790×10^8	8.6803	37	43.1387	62	85.4979	87	132.3238
13		9.7943	38	44.7185	63	87.2972	88	134.2683
14		10.9404	39	46.3096	64	89.1034	89	136.2177
15		12.1165	40	47.9116	65	90.9163	90	138.1719
16		13.3206	41	49.5244	66	92.7359	91	140.1310
17		14.5511	42	51.1477	67	94.5619	92	142.0948
18		15.8063	43	52.7811	68	96.3945	93	144.0632
19		17.0851	44	54.4246	69	98.2333	94	146.0364
20		18.3861	45	56.0778	70	100.0784	95	148.0141
21		19.7083	46	57.7406	71	101.9297	96	149.9964
22		21.0508	47	59.4127	72	103.7870	97	151.9831
23		22.4125	48	61.0939	73	105.6503	98	153.9744
24		23.7927	49	62.7841	74	107.5196	99	155.9700
25		25.1906	50	64.4831	75	109.3946	100	157.9700

From $n! = n(n\text{-}1)! \equiv \dfrac{(n+1)!}{n+1}$ then

(i) $\log_{10} n! = \log_{10} (n\text{-}1)! + \log_{10} n$ or $\equiv \log_{10} (n+1)! - \log(n+1)$ (for intermediate values of n)

(ii) $\log_{10} n! \equiv 0.3991 + (n + \tfrac{1}{2}) \log_{10} n - 0.43429n$ (for n relatively large)

DEGREES TO RADIANS

Degrees	Radians	Degrees	Radians	Degrees	Radians	Degrees	Radians
0	0.0000	**23**	0.4014	**46**	0.8029	**69**	1.2043
1	0.0175	**24**	0.4189	**47**	0.8203	**70**	1.2217
2	0.0349	**25**	0.4363	**48**	0.8378	**71**	1.2392
3	0.0524	**26**	0.4538	**49**	0.8552	**72**	1.2566
4	0.0698	**27**	0.4712	**50**	0.8727	**73**	1.2741
5	0.0873	**28**	0.4887	**51**	0.8901	**74**	1.2915
6	0.1047	**29**	0.5061	**52**	0.9076	**75**	1.3090
7	0.1222	**30**	0.5236	**53**	0.9250	**76**	1.3265
8	0.1396	**31**	0.5411	**54**	0.9425	**77**	1.3439
9	0.1571	**32**	0.5585	**55**	0.9599	**78**	1.3614
10	0.1745	**33**	0.5760	**56**	0.9774	**79**	1.3788
11	0.1920	**34**	0.5934	**57**	0.9948	**80**	1.3963
12	0.2094	**35**	0.6109	**58**	1.0123	**81**	1.4137
13	0.2269	**36**	0.6283	**59**	1.0297	**82**	1.4312
14	0.2443	**37**	0.6458	**60**	1.0472	**83**	1.4486
15	0.2618	**38**	0.6632	**61**	1.0647	**84**	1.4661
16	0.2793	**39**	0.6807	**62**	1.0821	**85**	1.4835
17	0.2967	**40**	0.6981	**63**	1.0996	**86**	1.5010
18	0.3142	**41**	0.7156	**64**	1.1170	**87**	1.5184
19	0.3316	**42**	0.7330	**65**	1.1345	**88**	1.5359
20	0.3491	**43**	0.7505	**66**	1.1519	**89**	1.5533
21	0.3665	**44**	0.7679	**67**	1.1694	**90**	1.5708
22	0.3840	**45**	0.7854	**68**	1.1868		

MINUTES TO RADIANS

Minutes	Radians	Minutes	Radians	Minutes	Radians
1	0.0003	**6**	0.0017	**20**	0.0058
2	0.0006	**7**	0.0020	**30**	0.0087
3	0.0009	**8**	0.0023	**40**	0.0116
4	0.0012	**9**	0.0026	**50**	0.0145
5	0.0015	**10**	0.0029	**60**	0.0175

To convert radians to degrees for angles other than those given in this table, use linear interpolation.

RADIANS TO DEGREES

Radians	Degrees	Radians	Degrees	Radians	Degrees	Radians	Degrees
0.0	0.0000	**1.0**	57.2958	**2.0**	114.5916	3.0	171.8873
0.1	5.7296	**1.1**	63.0254	**2.1**	120.3211	3.1	177.6169
0.2	11.4592	**1.2**	68.7549	**2.2**	126.0507	3.2	183.3465
0.3	17.1887	**1.3**	74.4845	**2.3**	131.7803		
0.4	22.9183	**1.4**	80.2141	**2.4**	137.5099		
0.5	28.6479	**1.5**	85.9437	**2.5**	143.2394		
0.6	34.3775	**1.6**	91.6732	**2.6**	148.9690		
0.7	40.1070	**1.7**	97.4028	**2.7**	154.6986		
0.8	45.8366	**1.8**	103.1324	**2.8**	160.4282		
0.9	51.5662	**1.9**	108.8620	**2.9**	166.1578		

To convert radians to degrees for angles other than those given in this table, use linear interpolation.

BINOMIAL COEFFICIENTS ^nC_r or $\binom{n}{r}$

n \ r	0	1	2	3	4	5	6	7	8	9	10	11
1	1	1										
2	1	2	1									
3	1	3	3	1								
4	1	4	6	4	1							
5	1	5	10	10	5	1						
6	1	6	15	20	15	6	1					
7	1	7	21	35	35	21	7	1				
8	1	8	28	56	70	56	28	8	1			
9	1	9	36	84	126	126	84	36	9	1		
10	1	10	45	120	210	252	210	120	45	10	1	
11	1	11	55	165	330	462	462	330	165	55	11	1
12	1	12	66	220	495	792	924	792	495	220	66	12
13	1	13	78	286	715	1287	1716	1716	1287	715	286	78
14	1	14	91	364	1001	2002	3003	3432	3003	2002	1001	364
15	1	15	105	455	1365	3003	5005	6435	6435	5005	3003	1365
16	1	16	120	560	1820	4368	8008	11440	12870	11440	8008	4368
17	1	17	136	680	2380	6188	12376	19448	24310	24310	19448	12376
18	1	18	153	816	3060	8568	18564	31824	43758	48620	43758	31824
19	1	19	171	969	3876	11628	27132	50388	75582	92378	92378	75582
20	1	20	190	1140	4845	15504	38760	77520	125970	167960	184756	167960
21	1	21	210	1330	5985	20349	54264	116280	203490	293930	352716	352716
22	1	22	231	1540	7315	26334	74613	170544	319770	497420	646646	705432
23	1	23	253	1771	8855	33649	100947	245157	490314	817190	1144066	1352078

For $r > 11$ use $\binom{n}{r} = \binom{n}{n-r}$

BINOMIAL PROBABILITIES (DISTRIBUTION) B(n,x), INDIVIDUAL TERMS Pr

		x									
n	r	0.01	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50
2	0	0.9801	9025	8100	7225	6400	5625	4900	4225	3600	3025	2500
	1	0.0198	0950	1800	2550	3200	3750	4200	4550	4800	4950	5000
	2	0.0001	0025	0100	0225	0400	0625	0900	1225	1600	2025	2500
3	0	0.9703	8574	7290	6141	5120	4219	3430	2746	2160	1664	1250
	1	0.0294	1354	2430	3251	3840	4219	4410	4436	4320	4084	3750
	2	0.0003	0071	0270	0574	0960	1406	1890	2389	2880	3341	3750
	3		0001	0010	0034	0080	0156	0270	0429	0640	0911	1250
4	0	0.9606	8145	6561	5220	4096	3164	2401	1785	1296	0915	0625
	1	0.0388	1715	2916	3685	4096	4219	4116	3845	3456	2995	2500
	2	0.0006	0135	0486	0975	1536	2109	2646	3105	3456	3675	3750
	3		0005	0036	0115	0256	0469	0756	1115	1536	2005	2500
	4			0001	0005	0016	0039	0081	0150	0256	0410	0625
5	0	0.9510	7738	5905	4437	3277	2373	1681	1160	0778	0503	0312
	1	0.0480	2036	3280	3915	4096	3955	3602	3124	2592	2059	1562
	2	0.0010	0214	0729	1382	2048	2637	3087	3364	3456	3369	3125
	3		0011	0081	0244	0512	0879	1323	1811	2304	2757	3125
	4			0004	0022	0064	0146	0284	0488	0768	1128	1562
	5				0001	0003	0010	0024	0053	0102	0185	0312
6	0	0.9415	7351	5314	3771	2621	1780	1176	0754	0467	0277	0156
	1	0.0571	2321	3543	3993	3932	3560	3025	2437	1866	1359	0938
	2	0.0014	0305	0984	1762	2458	2966	3241	3280	3110	2780	2344
	3		0021	0146	0415	0819	1318	1852	2355	2765	3032	3125
	4		0001	0012	0055	0154	0330	0595	0951	0382	1861	2344
	5			0001	0004	0015	0044	0102	0205	0369	0609	0938
	6					0001	0002	0007	0018	0041	0083	0156
7	0	0.9321	6983	4783	3206	2097	1335	0824	0490	0280	0152	0078
	1	0.0659	2573	3720	3960	3670	3115	2471	1848	1306	0872	0547
	2	0.0020	0406	1240	2097	2753	3115	3177	2985	2613	2140	1641
	3		0036	0230	0617	1147	1730	2269	2679	2903	2918	2734
	4		0002	0026	0109	0287	0577	0972	1442	1935	2388	2734
	5			0002	0012	0043	0115	0250	0466	0774	1172	1641
	6				0001	0004	0013	0036	0084	0172	0320	0547
	7						0001	0002	0006	0016	0037	0078
8	0	0.9227	6634	4305	2725	1678	1001	0576	0319	0168	0084	0039
	1	0.0746	2793	3826	3847	3355	2670	1977	1373	0896	0548	0312
	2	0.0026	0515	1488	2376	2936	3115	2965	2587	2090	1569	1094
	3	0.0001	0054	0331	0839	1468	2076	2541	2786	2787	2568	2188
	4		0004	0046	0185	0459	0865	1361	1875	2322	2627	2734
	5			0004	0026	0092	0231	0467	0808	1239	1719	2188
	6				0002	0011	0038	0100	0217	0413	0703	1094
	7					0001	0004	0012	0033	0079	0164	0312
	8							0001	0002	0007	0017	0039
9	0	0.9135	6302	3874	2316	1342	0751	0404	0207	0101	0046	0020
	1	0.0830	2985	3874	3679	3020	2253	1556	1004	0605	0339	0176
	2	0.0034	0629	1722	2597	3020	3003	2668	2162	1612	1110	0703
	3	0.0001	0077	0446	1069	1762	2336	2668	2716	2508	2119	1641
	4		0006	0074	0283	0661	1168	1715	2194	2508	2600	2461
	5			0008	0050	0165	0389	0735	1181	1672	2128	2461
	6			0001	0006	0028	0087	0210	0424	0743	1160	1641
	7					0003	0012	0039	0098	0212	0407	0703
	8						0001	0004	0013	0035	0083	0176
	9								0001	0003	0008	0020
10	0	0.9044	5987	3487	1969	1074	0563	0282	0135	0060	0025	0010
	1	0.0914	3151	3874	3474	2684	1877	1211	0725	0403	0207	0098
	2	0.0042	0746	1937	2759	3020	2816	2335	1757	1209	0763	0439
	3	0.0001	0105	0574	1298	2013	2503	2668	2522	2150	1665	1172
	4		0010	0112	0401	0881	1460	2001	2377	2508	2384	2051
	5		0001	0015	0085	0264	0584	1029	1536	2007	2340	2461
	6			0001	0012	0055	0162	0368	0689	1115	1596	2051
	7				0001	0008	0031	0090	0212	0425	0746	1172

Where a space in the table is empty the probability is less than 0.00005.

BINOMIAL PROBABILITIES (DISTRIBUTION) B(n,x), INDIVIDUAL TERMS Pr

n	r	x 0.01	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50
10	8					0001	0004	0014	0043	0106	0229	0439
	9							0001	0005	0016	0042	0098
	10									0001	0003	0010
11	0	0.8953	5688	3138	1673	0859	0422	0198	0088	0036	0014	0005
	1	0.0995	3293	3835	3248	2362	1549	0932	0518	0266	0125	0054
	2	0.0050	0867	2131	2866	2953	2581	1998	1395	0887	0513	0269
	3	0.0002	0137	0710	1517	2215	2581	2568	2254	1774	1259	0806
	4		0014	0158	0536	1107	1721	2201	2428	2365	2060	1611
	5		0001	0025	0132	0388	0803	1321	1830	2207	2360	2256
	6			0003	0023	0097	0268	0566	0985	1471	1931	2256
	7				0003	0017	0064	0173	0379	0701	1128	1611
	8					0002	0011	0037	0102	0234	0462	0806
	9						0001	0005	0018	0052	0126	0269
	10								0002	0007	0021	0054
	11										0002	0005
12	0	0.8864	5404	2824	1422	0687	0317	0138	0057	0022	0008	0002
	1	0.1074	3413	3766	3012	2062	1267	0712	0368	0174	0075	0029
	2	0.0060	0988	2301	2924	2835	2323	1678	1088	0639	0339	0161
	3	0.0002	0173	0852	1720	2362	2581	2397	1954	1419	0923	0537
	4		0021	0213	0683	1329	1936	2311	2367	2128	1700	1208
	5		0002	0038	0193	0532	1032	1585	2039	2270	2225	1934
	6			0005	0040	0155	0401	0792	1281	1766	2124	2256
	7				0006	0033	0115	0291	0591	1009	1489	1934
	8				0001	0005	0024	0078	0199	0420	0762	1208
	9					0001	0004	0015	0048	0125	0277	0537
	10							0002	0008	0025	0068	0161
	11								0001	0003	0010	0029
	12										0001	0002
15	0	0.8601	4633	2059	0874	0352	0134	0047	0016	0005	0001	
	1	0.1303	3658	3432	2312	1319	0668	0305	0126	0047	0016	0005
	2	0.0092	1348	2669	2856	2309	1559	0916	0476	0219	0090	0032
	3	0.0004	0307	1285	2184	2501	2252	1700	1110	0634	0318	0139
	4		0049	0428	1156	1876	2252	2186	1792	1268	0780	0417
	5		0006	0105	0449	1032	1651	2061	2123	1859	1404	0916
	6			0019	0132	0430	0917	1472	1906	2066	1914	1527
	7			0003	0030	0138	0393	0811	1319	1771	2013	1964
	8				0005	0035	0131	0348	0710	1181	1647	1964
	9				0001	0007	0034	0116	0298	0612	1048	1527
	10					0001	0007	0030	0096	0245	0515	0916
	11						0001	0006	0024	0074	0191	0417
	12							0001	0004	0016	0052	0139
	13								0001	0003	0010	0032
	14										0001	0005
20	0	0.8179	3585	1216	0388	0115	0032	0008	0002			
	1	0.1652	3774	2702	1368	0576	0211	0068	0020	0005	0001	
	2	0.0159	1887	2852	2293	1369	0669	0278	0100	0031	0008	0002
	3	0.0010	0596	1901	2428	2054	1339	0716	0323	0123	0040	0011
	4		0133	0898	1821	2182	1897	1304	0738	0350	0139	0046
	5		0022	0319	1028	1746	2023	1789	1272	0746	0365	0148
	6		0003	0089	0454	1091	1686	1916	1712	1244	0746	0370
	7			0020	0160	0545	1124	1643	1844	1659	1221	0739
	8			0004	0046	0222	0609	1144	1614	1797	1623	1201
	9			0001	0011	0074	0271	0654	1158	1597	1771	1602
	10				0002	0020	0099	0308	0686	1171	1593	1762
	11					0005	0030	0120	0336	0710	1185	1602
	12					0001	0008	0039	0136	0355	0727	1201
	13						0002	0010	0045	0146	0366	0739
	14							0002	0012	0049	0150	0370
	15								0003	0013	0049	0148
	16									0003	0013	0046
	17										0002	0011
	18											0002

If the probability of success in a single trial is x the probability Pr of exactly r successes in n independent trials is given by the binomial or Bernoulli distribution B(n, x_p):

$$Pr = \binom{n}{r} x^r (1-x)^{n-r}$$

CUMULATIVE BINOMIAL PROBABILITY (DISTRIBUTION) $\sum_{i \geq r} pi$

		x										
n	r	0.01	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50
2	1	0.0199	0975	1900	2775	3600	4375	5100	5775	6400	6975	7500
	2	0.0001	0025	0100	0225	0400	0625	0900	1225	1600	2025	2500
3	1	0.0297	1426	2710	3859	4880	5781	6570	7254	7840	8336	8750
	2	0.0003	0072	0280	0608	1040	1562	2160	2818	3520	4252	5000
	3		0001	0010	0034	0080	0156	0270	0429	0640	0911	1250
4	1	0.0394	1855	3439	4780	5904	6836	7599	8215	8704	9085	9375
	2	0.0006	0140	0523	1095	1808	2617	3483	4370	5248	6090	6875
	3		0005	0037	0120	0272	0508	0837	1265	1792	2415	3125
	4			0001	0005	0016	0039	0081	0150	0256	0410	0625
5	1	0.0490	2262	4095	5563	6723	7627	8319	8840	9222	9497	9688
	2	0.0010	0226	0815	1648	2627	3672	4718	5716	6630	7438	8125
	3		0012	0086	0266	0579	1035	1631	2352	3174	4069	5000
	4			0005	0022	0067	0156	0308	0540	0870	1312	1875
	5				0001	0003	0010	0024	0053	0102	0185	0312
6	1	0.0585	2649	4686	6229	7379	8220	8824	9246	9533	9723	9844
	2	0.0015	0328	1143	2235	3446	4661	5798	6809	7667	8364	8906
	3		0022	0158	0473	0989	1694	2557	3529	4557	5585	6562
	4		0001	0013	0059	0170	0376	0705	1174	1792	2553	3438
	5			0001	0004	0016	0046	0109	0223	0410	0692	1094
	6					0001	0002	0007	0018	0041	0083	0156
7	1	0.0679	3017	5217	6794	7903	8665	9176	9510	9720	9848	9922
	2	0.0020	0444	1497	2834	4233	5551	6706	7662	8414	8976	9375
	3		0038	0257	0738	1480	2436	3529	4677	5801	6836	7734
	4		0002	0027	0121	0333	0706	1260	1998	2898	3917	5000
	5			0002	0012	0047	0129	0288	0556	0963	1529	2266
	6				0001	0004	0013	0038	0090	0188	0357	0625
	7						0001	0002	0006	0016	0037	0078
8	1	0.0773	3366	5695	7275	8322	8999	9424	9681	9832	9916	9961
	2	0.0027	0572	1869	3428	4967	6329	7447	8309	8936	9368	9648
	3	0.0001	0058	0381	1052	2031	3215	4482	5722	6846	7799	8555
	4		0004	0050	0214	0563	1138	1941	2936	4059	5230	6367
	5			0004	0029	0104	0273	0580	1061	1737	2604	3633
	6				0002	0012	0042	0113	0253	0498	0885	1445
	7					0001	0004	0013	0036	0085	0181	0352
	8							0001	0002	0007	0017	0039
9	1	0.0865	3698	6126	7684	8658	9249	9596	9793	9899	9954	9980
	2	0.0034	0712	2252	4005	5638	6997	8040	8789	9295	9615	9805
	3	0.0001	0084	0530	1409	2618	3993	5372	6627	7682	8505	9102
	4		0006	0083	0339	0856	1657	2703	3911	5174	6386	7461
	5			0009	0056	0196	0489	0988	1717	2666	3786	5000
	6			0001	0006	0031	0100	0253	0536	0994	1658	2539
	7					0003	0013	0043	0112	0250	0498	0898
	8						0001	0004	0014	0038	0091	0195
	9								0001	0003	0008	0020
10	1	0.0956	4013	6513	8031	8926	9437	9718	9865	9940	9975	9990
	2	0.0043	0861	2639	4557	6242	7560	8507	9140	9536	9767	9893
	3	0.0001	0115	0702	1798	3222	4744	6172	7384	8327	9004	9453
	4		0010	0128	0500	1209	2241	3504	4862	6177	7340	8281
	5		0001	0016	0099	0328	0781	1503	2485	3669	4956	6230
	6			0001	0014	0064	0197	0473	0949	1662	2616	3770
	7				0001	0009	0035	0106	0260	0548	1020	1719
	8					0001	0004	0016	0048	0123	0274	0547
	9							0001	0005	0017	0045	0107
	10									0001	0003	0010
11	1	0.1047	4312	6862	8327	9141	9578	9802	9912	9964	9986	9995
	2	0.0052	1019	3026	5078	6779	8029	8870	9394	9698	9861	9941
	3	0.0002	0152	0896	2212	3826	5448	6873	7999	8811	9348	9673
	4		0016	0185	0694	1611	2867	4304	5744	7037	8089	8867
	5		0001	0028	0159	0504	1146	2103	3317	4672	6029	7256

CUMULATIVE BINOMIAL PROBABILITY (DISTRIBUTION)

							x				
n	r	0.01	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50
11	6			0003	0027	0117	0343	0782	1487	2465	3669	5000
	7				0003	0020	0076	0216	0501	0994	1738	2744
	8					0002	0012	0043	0122	0293	0610	1133
	9						0001	0006	0020	0059	0148	0327
	10								0002	0007	0022	0059
	11										0002	0005
12	1	0.1136	4596	7176	8578	9313	9683	9862	9943	9978	9992	9998
	2	0.0062	1184	3410	5565	7251	8416	9150	9576	9804	9917	9968
	3	0.0002	0196	1109	2642	4417	6093	7472	8487	9166	9579	9807
	4		0022	0256	0922	2054	3512	5075	6533	7747	8655	9270
	5		0002	0043	0239	0726	1576	2763	4167	5618	6956	8062
	6			0005	0046	0194	0544	1178	2127	3348	4731	6128
	7			0001	0007	0039	0143	0386	0846	1582	2607	3872
	8				0001	0006	0028	0095	0255	0573	1117	1938
	9					0001	0004	0017	0056	0153	0356	0730
	10							0002	0008	0028	0079	0193
	11								0001	0003	0011	0032
	12										0001	0002
15	1	0.1399	5367	7941	9126	9648	9866	9953	9984	9995	9999	1.0000
	2	0.0096	1710	4510	6814	8329	9198	9647	9858	9948	9983	9995
	3	0.0004	0362	1841	3958	6020	7639	8732	9383	9729	9893	9963
	4		0055	0556	1773	3518	5387	7031	8273	9095	9576	9824
	5		0006	0127	0617	1642	3135	4845	6481	7827	8796	9408
	6		0001	0022	0168	0611	1484	2784	4357	5968	7392	8491
	7			0003	0036	0181	0566	1311	2452	3902	5478	6964
	8				0006	0042	0173	0500	1132	2131	3465	5000
	9				0001	0008	0042	0152	0422	0950	1818	3036
	10					0001	0008	0037	0124	0338	0769	1509
	11						0001	0007	0028	0093	0255	0592
	12							0001	0005	0019	0063	0176
	13								0001	0003	0011	0037
	14										0001	0005
20	1	0.1821	6415	8784	9612	9885	9968	9992	9998	1.0000	1.0000	1.0000
	2	0.0169	2642	6083	8244	9308	9757	9924	9979	9995	9999	1.0000
	3	0.0010	0755	3231	5951	7939	9087	9645	9879	9964	9991	9998
	4		0159	1330	3523	5886	7748	8929	9556	9840	9951	9987
	5		0026	0432	1702	3704	5852	7625	8818	9490	9811	9941
	6		0003	0113	0673	1958	3828	5836	7546	8744	9447	9793
	7			0024	0219	0867	2142	3920	5834	7500	8701	9423
	8			0004	0059	0321	1018	2277	3990	5841	7480	8684
	9			0001	0013	0100	0409	1133	2376	4044	5857	7483
	10				0002	0026	0139	0480	1218	2447	4086	5881
	11					0006	0039	0171	0532	1275	2493	4119
	12					0001	0009	0051	0196	0565	1308	2517
	13						0002	0013	0060	0210	0580	1316
	14							0003	0015	0065	0214	0577
	15								0003	0016	0064	0207
	16									0003	0015	0059
	17										0003	0013
	18											0002

To obtain $p(i \leq r)$ use: $p(i \leq r) = 1 - p(i \geq r + 1)$

Where a space in the table is empty the probability is less than 0.00005.

NORMAL DISTRIBUTION N(0,1) $\phi(Z)$

Z	0	1	2	3	4	5	6	7	8	9
0.0	0.3989	3989	3989	3988	3986					
0.1	0.3970	3965	3961	3956	3951	3984	3982	3980	3977	3973
0.2	0.3910	3902	3894	3885	3876	3945	3939	3932	3925	3918
0.3	0.3814	3802	3790	3778	3765	3867	3857	3847	3836	3825
0.4	0.3683	3668	3653	3637	3621	3752 3605	3739 3589	3725 3572	3712 3555	3697 3538
0.5	0.3521	3503	3485	3467	3448	3429	3410	3391	3372	3352
0.6	0.3332	3312	3292	3271	3251	3230	3209	3187	3166	3144
0.7	0.3123	3101	3079	3056	3034	3011	2989	2966	2943	2920
0.8	0.2897	2874	2850	2827	2803	2780	2756	2732	2709	2685
0.9	0.2661	2637	2613	2589	2565	2541	2516	2492	2468	2444
1.0	0.2420	2396	2371	2347	2323	2299	2275	2251	2227	2203
1.1	0.2179	2155	2131	2107	2083	2059	2036	2012	1989	1965
1.2	0.1942	1919	1895	1872	1849	1826	1804	1781	1758	1736
1.3	0.1714	1691	1669	1647	1626	1604	1582	1561	1539	1518
1.4	0.1497	1476	1456	1435	1415	1394	1374	1354	1334	1315
1.5	0.1295	1276	1257	1238	1219	1200	1182	1163	1145	1127
1.6	0.1109	1092	1074	1057	1040	1023	1006	0989	0973	0957
1.7	0.0940	0925	0909	0893	0878	0863	0848	0833	0818	0804
1.8	0.0790	0775	0761	0748	0734					
1.9	0.0656	0644	0632	0620	0608	0721 0596	0707 0584	0694 0573	0681 0562	0669 0551
2.0	0.0540	0529	0519	0508	0498	0488	0478	0468	0459	0449
2.1	0.0440	0431	0422	0413	0404	0396	0387	0379	0371	0363
2.2	0.0355	0347	0339	0332	0325	0317	0310	0303	0297	0290
2.3	0.0283	0277	0270	0264	0258	0252	0246	0241	0235	0229
2.4	0.0224	0219	0231	0208	0203	0198	0194	0189	0184	0180
2.5	0.0175	0171	0167	0163	0158	0154	0151	0147	0143	0139
2.6	0.0136	0132	0129	0126	0122	0119	0116	0113	0110	0107
2.7	0.0104	0101	0099	0096	0093	0091	0088	0086	0084	0081
2.8	0.0079	0077	0075	0073	0071	0069	0067	0065	0063	0061
2.9	0.0060	0058	0056	0055	0053	0051	0050	0048	0047	0046
3.	0.0044	0033	0024	0017	0012	0009	0006	0004	0003	0002

SUBTRACT								
1	2	3	4	5	6	7	8	9
0	1	1	1	1	2	2	2	3
0	1	1	2	2	3	3	4	4
1	1	2	3	3	4	5	6	6
1	2	3	4	4	5	6	7	8
1	2	3	4	5	7	8	9	10
1	2	4	5	6	7	8	10	11
1	3	4	6	7	8	10	11	13
2	3	5	6	8	10	11	13	14
2	4	6	8	10	11	13	15	17
2	4	6	8	10	13	15	17	19
2	5	7	9	11	14	16	18	21
2	5	7	10	12	14	17	19	22
2	5	7	10	12	14	17	19	22
2	5	7	10	12	14	17	19	22
2	5	7	10	12	14	17	19	22
2	5	7	9	12	14	16	18	21
2	4	7	9	11	13	15	18	20
2	4	6	8	10	12	14	16	18
2	4	6	8	9	11	13	15	17
2	3	5	7	8	10	12	14	15
2	3	5	6	8	9	11	12	14
1	3	4	6	7	8	10	11	13
1	3	4	5	7	8	9	10	12
1	2	4	5	6	7	8	10	11
1	2	3	4	5	6	7	8	9
1	2	3	4	4	5	6	7	8
1	1	2	3	4	4	5	6	6
1	1	2	2	3	4	5	6	6
0	1	1	2	2	3	4	5	5
0	1	1	2	2	3	3	4	4
0	1	1	1	2	2	2	3	3
0	1	1	1	1	2	2	2	3
1	2	3	4	5	6	7	8	9
1	1	2	2	3	4	4	5	5

The functions tabled are:

$\phi(Z) = \sqrt{\left(\frac{1}{2\pi}\right)} \exp(-\frac{1}{2} Z^2)$, where $\phi(Z)$ is the probability density of the standardized normal distribution N(0,1)

CRITICAL POINTS OF THE NORMAL DISTRIBUTION Z_p

P	Q	z	P	Q	z	P	Q	z
.00	.50	0.000	.460	.040	1.751	.490	.010	2.326
.05	.45	0.126	.462	.038	1.774	.491	.009	2.366
.10	.40	0.253	.464	.036	1.799	.492	.008	2.409
.15	.35	0.385	.466	.034	1.825	.493	.007	2.457
.20	.30	0.524	.468	.032	1.852	.494	.006	2.512
.25	.25	0.674	.470	.030	1.881	.495	.005	2.576
.30	.20	0.842	.472	.028	1.911	.496	.004	2.652
.35	.15	1.036	.474	.026	1.943	.497	.003	2.748
.40	.10	1.282	.476	.024	1.977	.498	.002	2.878
.45	.05	1.645	.478	.022	2.014	.499	.001	3.090
.450	.050	1.645	.480	.020	2.054	.4995	.0005	3.291
.452	.048	1.665	.482	.018	2.097	.4999	.0001	3.719
.454	.046	1.685	.484	.016	2.144	.49995	.00005	3.891
.456	.044	1.706	.486	.014	2.197	.49999	.00001	4.265
.458	.042	1.728	.488	.012	2.257	.499995	.000005	4.417

CUMULATIVE NORMAL DISTRIBUTION $P(z)$

Z	0	1	2	3	4	5	6	7	8	9
0.0	0.0000	0040	0080	0120	0160	0199	0239	0279	0319	0359
0.1	0.0398	0438	0478	0517	0557	0596	0636	0675	0714	0753
0.2	0.0793	0832	0871	0910	0948	0987	1026	1064	1103	1141
0.3	0.1179	1217	1255	1293	1331	1368	1406	1443	1480	1517
0.4	0.1554	1591	1628	1664	1700	1736	1772	1808	1844	1879
0.5	0.1915	1950	1985	2019	2054	2088	2123	2157	2190	2224
0.6	0.2257	2291	2324	2357	2389	2422	2454	2486	2517	2549
0.7	0.2580	2611	2642	2673	2704	2734	2764	2794	2823	2852
0.8	0.2881	2910	2939	2967	2995	3023	3051	3078	3106	3133
0.9	0.3159	3186	3212	3238	3264	3289	3315	3340	3365	3389
1.0	0.3413	3438	3461	3485	3508	3531	3554	3577	3599	3621
1.1	0.3643	3665	3686	3708	3729	3749	3770	3790	3810	3830
1.2	0.3849	3869	3888	3907	3925	3944	3962	3980	3997	4015
1.3	0.4032	4049	4066	4082	4099	4115	4131	4147	4162	4177
1.4	0.4192	4207	4222	4236	4251	4265	4279	4292	4306	4319
1.5	0.4332	4345	4357	4370	4382	4394	4406	4418	4429	4441
1.6	0.4452	4463	4474	4484	4495	4505	4515	4525	4535	4545
1.7	0.4554	4564	4573	4582	4591	4599	4608	4616	4625	4633
1.8	0.4641	4649	4656	4664	4671	4678	4686	4693	4699	4706
1.9	0.4713	4719	4726	4732	4738	4744	4750	4756	4761	4767
2.0	0.4772	4778	4783	4788	4793	4798	4803	4808	4812	4817
2.1	0.4821	4826	4830	4834	4838	4842	4846	4850	4854	4957
2.2	0.4861	4864	4868	4871	4875	4878	4881	4884	4887	4890
2.3	0.4893	4896	4898	4901	4904	4906	4909	4911	4913	4916
2.4	0.4918	4920	4922	4925	4927	4929	4931	4932	4934	4936
2.5	0.4938	4940	4941	4943	4945	4946	4948	4949	4951	4952
2.6	0.4953	4955	4956	4957	4959	4960	4961	4962	4963	4964
2.7	0.4965	4966	4967	4968	4969	4970	4971	4972	4973	4974
2.8	0.4974	4975	4976	4977	4977	4978	4979	4979	4980	4981
2.9	0.4981	4982	4982	4983	4984	4984	4985	4985	4986	4986
3.0	0.4987	4990	4993	4995	4997	4998	4998	4999	4999	5000

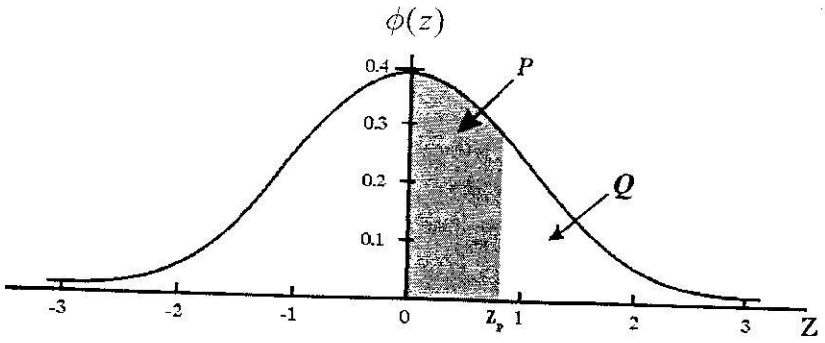
ADD

1	2	3	4	5	6	7	8	9
4	8	12	16	20	24	28	32	36
4	8	12	16	20	24	28	32	36
4	8	12	15	19	22	27	31	35
4	8	11	15	19	22	26	30	34
4	7	11	14	18	22	25	29	32
3	7	10	14	17	21	24	27	31
3	6	10	13	16	19	23	26	29
3	6	9	12	15	19	22	25	28
3	6	9	12	15	18	21	24	27
3	6	8	11	14	17	20	22	25
3	5	8	11	13	16	19	22	24
3	5	8	10	13	16	18	21	23
2	5	7	10	12	15	17	20	22
2	5	7	10	12	14	17	19	22
2	4	7	9	11	13	15	18	20
2	4	6	8	11	13	15	17	19
2	4	6	8	10	12	14	16	18
2	4	6	8	10	11	13	15	17
2	4	5	7	9	11	13	14	16
2	3	5	6	8	10	11	13	14
1	3	4	6	7	8	10	11	13
1	2	4	5	6	7	8	10	11
1	2	3	4	5	6	7	8	9
1	2	3	3	4	5	6	7	8
1	1	2	3	4	4	5	6	6
1	1	2	2	3	4	4	5	5
0	1	1	2	2	3	3	4	4
0	1	1	2	2	2	3	3	4
0	1	1	1	2	2	2	3	3
0	0	1	1	1	2	2	2	2
0	0	1	1	1	1	1	2	2

The table gives $P(z) = \int_0^z \phi(z)dz$

If the random variable Z is distributed as the standard normal distribution N(0,1) then:

1. $P(o < Z < z_p) = P$(Shaded Area)
2. $P(Z > Z_p) = Q = ½ - P$
3. $P(Z > |Z_p|) = 1 - 2P = 2Q$



PRODUCT-MOMENT CORRELATION COEFFICIENT r
PERCENTAGE POINTS OF THE SAMPLING DISTRIBUTION FOR $\rho = 0$

	Probability						Probability				
Q	.05	.025	.005	.0025	.0005	Q	.05	.025	.005	.0025	.0005
2Q	.10	.050	.010	.0050	.0010	2Q	.10	.050	.010	.0050	.0010
ν						ν					
1	0.9877	.9969	$.9^{3}88$	$.9^{4}69$	$.9^{5}88$	16	0.400	.468	.590	.631	.708
2	0.9000	.9500	.9900	.9950	$.9^{3}00$	17	0.389	.456	.575	.616	.693
3	0.805	.878	.9587	.9740	9911	18	0.378	.444	.561	.602	.679
4	0.729	.811	.9172	.9417	.9741	19	0.369	.433	.549	.589	.665
5	0.669	.754	.875	.9056	.9509	20	0.360	.423	.537	.576	.652
6	0.621	.707	.834	.870	.9249	25	0.323	.381	.487	.524	.597
7	0.582	.666	.798	.836	.898	30	0.296	.349	.449	.484	.554
8	0.549	.632	.765	.805	.872	35	0.275	.325	.418	.452	.519
9	0.521	.602	.735	.776	.847	40	0.257	.304	.393	.425	.490
10	0.497	.576	.708	.750	.823	45	0.243	.288	.372	.403	.465
11	0.476	.553	.684	.726	.801	50	0.231	.273	.354	.384	.443
12	0.457	.532	.661	.703	.780	60	0.211	.250	.325	.352	.408
13	0.441	.514	.641	.683	.760	70	0.195	.232	.302	.327	.380
14	0.426	.497	.623	.664	.742	80	0.183	.217	.283	.307	.357
15	0.412	.482	.606	.647	.725	90	0.173	.205	.267	.290	.338
						100	0.164	.195	.254	.276	.321

A sample of size n drawn from a population of pairs; r is the correlation coefficient of the sample and ρ is the true coefficient of the population. These tables relate to the use of r as an estimator of ρ.

The table is used to test the null hypothesis $\rho = 0$; it gives, for selected values of Q, the values of r_Q such that $r > r_Q$ with probability Q (single-tail test) and $r > r_Q$ with probability 2Q (two-tail test). The appropriate degree of freedom is $\nu = n - 2$.

SIGNIFICANCE LEVELS FOR CORRELATION COEFFICEINTS

	Product-moment coefficient of correlation (r_{xy})		Spearman's rank Correlation coefficient (ρ)		Kendall's rank coefficient of correlation (τ)	
No. of pairs	Significance if $\lvert r_{xy} \rvert$ exceeds at 5%	at 1%	Significance if $\lvert \rho \rvert$ exceeds at 5%	at 1%	Significance if $\lvert \tau \rvert$ exceeds at 5%	at 1%
3	1.00	1.00				
4	0.95	0.99				
5	0.88	0.96	1.00			
6	0.81	0.92	0.89	1.00	0.87	1.00
7	0.75	0.88	0.75	0.89	0.71	0.81
8	0.71	0.83	0.71	0.86	0.64	0.79
9	0.67	0.80	0.68	0.83	0.56	0.72
10	0.63	0.77	0.65	0.79	0.51	0.64
11	0.60	0.74	0.60	0.74	0.49	0.60
12	0.58	0.71	0.58	0.71	0.45	0.58
13	0.55	0.68	0.55	0.68		
14	0.53	0.66	0.53	0.66		
15	0.51	0.64	0.51	0.64		
16	0.50	0.62	0.50	0.62		
17	0.48	0.61	0.48	0.61		
18	0.47	0.59	0.47	0.59		
19	0.46	0.58	0.46	0.58		
20	0.44	0.56	0.44	0.56	0.33	
30	0.35	0.45	0.35	0.45		
40	0.31	0.39	0.31	0.39		
50	0.27	0.35	0.27	0.35		
60	0.25	0.33	0.25	0.33		
70	0.23	0.31	0.23	0.31		
80	0.22	0.29	0.22	0.29		
90	0.21	0.27	0.21	0.27		
100	0.20	0.25	0.20	0.25		

MATHEMATICAL FORMULAE

ALGEBRA

Logarithms

1. $\log_a x = \dfrac{\log_b x}{\log_b a}$

Structure

2. A group G is a set of elements $x,y,z,\ldots$ with a single binary operation * such that:
   (i) $x * y \in G$ for all $x,y, \in G$ (closure),
   (ii) $(x * y) * z = x * (y * z)$ for all $x,y,z \in G$ (associativity),
   (iii) there is an element e of G such that $x * e = x = e * x$ for any $x \in G$
   (iv) to every $x \in G$, there corresponds an inverse element x^{-1} such that $x * x^{-1} = e = x^{-1} * x$.

3. An isomorphism I between two groups (G, *) and (H,o) is a one-to-one mapping $a \to f(a)$, where $a \in G$ and $f(a) \in H$, such that $f(a * b) = f(a)$ o $f(b)$.

4. An equivalence relation R between the elements of a set S is a relation such that
   (i) aRa for all a in S (R is reflexive),
   (ii) $aRb \Rightarrow bRa$ for all a, b in S (symmetric),
   (iii) (aRb and bRc) $\Rightarrow aRc$ for all a, b, c, in S (transitive)

5. A field is a set with two binary operations *, o each having the properties listed under 2 above together with commutativity and with one operation * distributive over the other operation o (and with the single exception that the neutral element for the first operation * has no inverse under the second operation o).

Series

6. $\sum_1^n r = \dfrac{n(n+1)}{2}$; $\sum_1^n r^2 = \dfrac{n(n+1)(2n+1)}{6}$; $\sum_1^n r^3 = \dfrac{n^2(n+1)^2}{4}$.

7. For the arithmetic sequence a, a + d, …, a + (n-1)d,

$$S_n = \frac{n}{2}\{2a + (n-1)d\}.$$

8. For the geometric sequence a, ar, ar^2, …, ar^{n-1},

$$S_n = \frac{a(r^n - 1)}{r - 1} = \frac{a(1 - r^n)}{1 - r}$$

If $-1 < r < 1, Lt_{n\to\infty}\ S_n = \dfrac{a}{1 - r}$

Complex numbers

9. $\{r(\cos\theta + i\sin\theta)\}^n = r^n(\cos n\theta + i\sin n\theta)$

$e^{i\theta} = \cos\theta + i\sin\theta$

The roots of $z^n = 1$ are given by $z = e^{\frac{2\pi ki}{n}}$ for $k = 0, 1, 2, \ldots$.

10. Binomial: $(x+y)^n = x^n + nx^{n-1}y + \frac{n(n-1)}{2!}x^{n-2}y^2 + \frac{n(n-1)(n-2)}{3!}x^{n-3}y^3 + \ldots$

Quadratic Equation

11. $ax^2 + bx + c = 0$ has roots $\frac{\{-b \pm \sqrt{(b^2 - 4ac)}\}}{2a}$

TRIGONOMETRY

Trigonometrical Identities

12. $\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$

13. $\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$

14. $\tan(A \pm B) = \frac{\tan A \pm \tan B}{1 \mp \tan A \tan B}$

15. $\sin 2A = 2\cos A \sin A$

16. $\cos 2A = \cos^2 A - \sin^2 A = 1 - 2\sin^2 A = 2\cos^2 A - 1$

17. $\sin 3A = 3\sin A - 4\sin^3 A$

18. $\cos 3A = 4\cos^3 A - 3\cos A$

19. If $t = \tan \frac{1}{2} A$, *then* $\sin A = \frac{2t}{1 + t^2}$, $\cos A = \frac{1 - t^2}{1 + t^2}$, $\tan A = \frac{2t}{1 - t^2}$

20. $\sin A + \sin B = 2\sin \frac{1}{2}(A + B)\cos \frac{1}{2}(A - B)$.

21. $\sin A - \sin B = 2\cos \frac{1}{2}(A + B)\sin \frac{1}{2}(A - B)$.

22. $\cos A + \cos B = 2\cos \frac{1}{2}(A + B)\cos \frac{1}{2}(A - B)$.

23. $\cos A - \cos B = -2\sin \frac{1}{2}(A + B)\sin \frac{1}{2}(A - B)$.

Ranges of Inverse Trigonometrical Functions

24. $\frac{-\pi}{2} \leq \sin^{-1} x \leq \frac{\pi}{2}$

25. $0 < \cos^{-1} x \leq \frac{\pi}{2}$

26. $\frac{-\pi}{2} \leq \tan^{-1} x \leq \frac{\pi}{2}$

Coordinate Geometry

27. The perpendicular distance from (h, k) to line $ax + by + c = 0$ is $\dfrac{|ah + bk + c|}{\sqrt{a^2 + b^2}}$

28. The acute angle between two lines with gradients m_1 and m_2 is $\tan^{-1}\left|\dfrac{m_1 - m_2}{1 + m_1 m_2}\right|$

Formulae for ΔABC

29. $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C} = 2R$

30. $a^2 = b^2 + c^2 - 2bc \cos A$

31. $\Delta = \dfrac{1}{2}ab \sin C = \sqrt{[s(s - a)(s - b)(s - c)]}$

32. $\sin \dfrac{A}{2} = \sqrt{\dfrac{(s - b)(s - c)}{bc}}$ *where* $s = \dfrac{a + b + c}{2}$

33. $\cos \dfrac{A}{2} = \sqrt{\dfrac{s(s - a)}{bc}}$

34. $\tan \dfrac{A}{2} = \sqrt{\dfrac{(s - b)(s - c)}{s(s - a)}}$

Mensuration

35. Ellipse (axes $2a$, $2b$): Perimeter $\approx 2\pi \sqrt{\dfrac{a^2 + b^2}{2}}$ $\quad Area = \pi ab$

36. Cylinder (radius r, height h): Area = $2\pi r(h + r)$, Volume = $\pi r^2 h$

37. Area of curved surface of cone = πrl, where l = slant height

38. Volume of cone or pyramid = $\dfrac{1}{3}Ah$, where A = base area, h = height

39. Sphere (radius r) : Area = $4\pi r^2$, Volume = $(\dfrac{4}{3})\pi r^3$

40. Area cut off a sphere by two parallel planes h apart = $2\pi rh$

41. **Conics**

	Ellipse	Parabola
Standard Form	$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$	$y^2=4ax$
Parametric Form	$(a\cos\theta, b\sin\theta)$	$(at^2, 2at)$
Eccentricity	$e<1$ $b^2=a^2(1-e^2)$	$e=1$
Foci	$(\pm ae, 0)$	$(a,0)$
Directrices	$x=\pm\frac{a}{e}$	$x=-a$

ANALYSIS

Expansions

42. $e^x = \exp(x) = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \ldots + \frac{x^n}{n!} + \ldots$, for all x

43. $\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \frac{x^9}{9!} - \ldots + (-1)^n \frac{x^{2n+1}}{(2n+1)!} + \ldots$, for all x

44. $\cos x = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \frac{x^7}{7!} - \ldots + (-1)^n \frac{x^{2n}}{2n!} + \ldots$, for all x

45. $\sinh x = x + \frac{x^3}{3!} + \frac{x^5}{5!} + \frac{x^7}{7!} + \ldots + \frac{x^{(2n+1)}}{(2n+1)!} + \ldots$ for all x

46. $\cosh x = 1 + \frac{x^2}{2!} + \frac{x^4}{4!} + \frac{x^6}{6!} + \ldots + \frac{x^{2n}}{2n!} + \ldots$ for all x

47. $\log_e(1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \ldots + (-1)^{n+1}\frac{x^n}{n} + \ldots$ valid for $-1 < x < 1$

48. $(1+x)^n = 1 + nx + \frac{n(n-1)}{2!}x^2 + \frac{n(n-1)(n-2)}{3!}x^3 \ldots + \binom{n}{r}x^n \ldots$ valid for $-1 < x < 1$

Differentiation

49. If $y = f(x)$, then $\frac{dy}{dx} = f'(x) = \lim_{h\to 0} \frac{f(x+h)-f(x)}{2h}$

$$= \lim_{h\to 0} \frac{f(a+h) - f(a-h)}{2h}$$

50.

$f(x)$		x^m	$\sin x$	$\cos x$	$\tan x$	a^x	e^{ax}	$\log_a x$
$\frac{df(x)}{dx}$		mx^{m-1}	$\cos x$	$-\sin x$	$\sec^2 x$	$a^x \log_e a$	ae^{ax}	$\frac{1}{x \log_e a}$

51. If $F(x) = f(x)g(x)$,

$F'(x) = f'(x)g(x) + f(x)g'(x)$;
i.e. $(f.g)' = f'.g + f.g'$

52. If $F(x) = f(g(x))$,

$F'(x) = (fg)' = f'(g).g'(x)$

53. $\left(\frac{u}{v}\right)' = \frac{vu' - uv'}{v^2}$

Integration (arbitrary constants have been omitted; $a > 0$)

54.

$f(x)$		$x^n (n \neq -1)$	x^{-1}	$\frac{1}{a^2 + x^2}$	$\frac{1}{\sqrt{(a^2 - x^2)}}$	$\tan x$
$\int f(x)dx$		$\frac{x^{n+1}}{n+1}$	$\log_e \lvert x \rvert$	$\frac{1}{a}\tan^{-1}\left(\frac{x}{a}\right)$	$\sin^{-1}\left(\frac{x}{a}\right)$	$\log_e \lvert \sec x \rvert$

55. By parts: $\int u\frac{dv}{dx}dx = uv - \int v\frac{du}{dx}dx$

NUMERICAL METHODS

56. Newton-Raphson Method: If a is an approximate root of $f(x) = 0$, then

$a - \frac{f(a)}{f'(a)}$ is generally a better approximation.

57. Taylor's series:

$$f(a + h) = f(a) + hf'(a) + \frac{h^2}{2!}f''(a) + \ldots$$

Approximations for $f'(a + h)$:

Linear $f(a + h) \simeq f(a) + hf'(a)$

Quadratic $f(a + h) \approx f(a) + hf'(a) + \frac{h^2}{2!}f''(a) + \ldots$

58. Maclaurin's: $f(x) = f(0) + \frac{f'(0)x}{1!} + \frac{f''(0)x^2}{2!} + \frac{f'''(0)x^3}{3!} + \ldots + \frac{f^n(0)x^n}{n!} + \ldots$

59. Trapezium Rule: $(x_n = x_0 + nh,\ y_r = f(x_r))$

$$\int_{x_0}^{x_n} f(x)dx \simeq \tfrac{1}{2}h[y_0 + 2(y_1 + y_2 \ldots + y_{n-1}) + y_n]$$

60. Simpson's Rule: $\int_a^b f(x)dx \simeq \frac{1}{3}h(y_0 + 4y_1 + y_2)$, *where* $h = \frac{1}{2}(b - a)$

VECTORS

61. The resolved part of $\underset{\sim}{a}$ in the direction of $\underset{\sim}{b}$ is $\frac{\underset{\sim}{a}.\underset{\sim}{b}}{|\underset{\sim}{b}|}$

62. The point dividing AB in the ratio $\lambda : \mu$ is $\frac{\mu\underset{\sim}{a} + \lambda\underset{\sim}{b}}{\lambda + \mu}$

63. $\underset{\sim}{a}.(\underset{\sim}{b} \times \underset{\sim}{c}) = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} = \underset{\sim}{b}.(\underset{\sim}{c} \times \underset{\sim}{a}) = \underset{\sim}{c}.(\underset{\sim}{a} \times \underset{\sim}{b})$

64. Products If $\underset{\sim}{a}, \underset{\sim}{b}$ are vectors in three-dimensional space and the angle between them is θ, then

(i) $\underset{\sim}{a}.\underset{\sim}{b} = ab\cos\theta$ (scalar product)

(ii) $\underset{\sim}{a} \times \underset{\sim}{b}$ is a vector of magnitude $ab\sin\theta$ and direction perpendicular to the plane of $\underset{\sim}{a}$ and $\underset{\sim}{b}$ such that $\underset{\sim}{a}, \underset{\sim}{b}, \underset{\sim}{a} \times \underset{\sim}{b}$ form a right-handed triple.

65. (i) $\underset{\sim}{a}.\underset{\sim}{b} = a_1b_1 + a_2b_2 + a_3b_3$

(ii) $\underset{\sim}{a} \times \underset{\sim}{b} = \begin{pmatrix} a_2b_3 - a_3b_2 \\ a_3b_1 - a_1b_3 \\ a_1b_2 - a_2b_1 \end{pmatrix}$

(iii) $\underset{\sim}{a}.(\underset{\sim}{b} \times \underset{\sim}{c}) = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} = \underset{\sim}{b}.(\underset{\sim}{a} \times \underset{\sim}{c}) = \underset{\sim}{c}.(\underset{\sim}{a} \times \underset{\sim}{b})$

66. If A is the point with position vector $\underset{\sim}{a} = a_1\underset{\sim}{i} + a_2\underset{\sim}{j} + a_3\underset{\sim}{k}$ and the direction vector $\underset{\sim}{b}$ is given by $\underset{\sim}{b} = b_1\underset{\sim}{i} + b_2\underset{\sim}{j} + b_3\underset{\sim}{k}$, then the straight line through A with direction vector $\underset{\sim}{b}$ has cartesian equation

$$\frac{x - a_1}{b_1} = \frac{y - a_2}{b_2} = \frac{z - a_3}{b_3} (= \lambda)$$

67. The plane through A with normal vector $n = n_1\underset{\sim}{i} + n_2\underset{\sim}{j} + n_3\underset{\sim}{k}$ has Cartesian equation $n_1x + n_2y + n_3z + d = 0$ where $d = -\underset{\sim}{a}.\underset{\sim}{n}$.

68. The plane through non-collinear points A, B and C has vector equation $\underset{\sim}{r} = \underset{\sim}{a} + \lambda(\underset{\sim}{b} - \underset{\sim}{a}) + \mu(\underset{\sim}{c} - \underset{\sim}{a}) = (1 - \lambda - \mu)\underset{\sim}{a} + \lambda\underset{\sim}{b} + \mu\underset{\sim}{c}$

69. The plane through the point with position vector $\underset{\sim}{a}$ and parallel to $\underset{\sim}{b}$ and $\underset{\sim}{c}$ has equation $\underset{\sim}{r} = \underset{\sim}{a} + s\underset{\sim}{b} + t\underset{\sim}{c}$

70. The perpendicular distance of (α, β, γ) from the plane $n_1x + n_2y + n_3z + d = 0$ is $\dfrac{|n_1\alpha + n_2\beta + n_3\gamma + d|}{\sqrt{n_1^2 + n_2^2 + n_3^2}}$

71. $\underset{\sim}{r} = \underset{\sim}{a} + t\underset{\sim}{b}$ is the line parallel to $\underset{\sim}{b}$ and passing through the point with position vector $\underset{\sim}{a}$.

72. $\underset{\sim}{r} = \underset{\sim}{a} + t\underset{\sim}{b} + s\underset{\sim}{c}$ is the plane parallel to $\underset{\sim}{b}$ and $\underset{\sim}{c}$ and passing through the point with position vector $\underset{\sim}{a}$.

73. If $\underset{\sim}{n} = \begin{pmatrix} a \\ b \\ c \end{pmatrix}$ is normal to a plane containing the point (p,q,r), the equation of the plane is

$$ax + by + cz = ap + bq + cr$$

MECHANICS

Motion in a circle

74. Transverse velocity: $v = r\dot{\theta}$

75. Transverse acceleration: $\dot{v} = r\ddot{\theta}$

76. Radial acceleration: $-r\dot{\theta}^2 = -\dfrac{v^2}{r}$

Centres of Mass: For uniform bodies

77. Traingular lamina: $\dfrac{2}{3}$ along median from vertex

78. Solid hemisphere, radius r: $\dfrac{3}{8}r$ from centre

79. Hemispherical shell, radius r: $\dfrac{1}{2}r$ from centre

80. Circular arc, radius r, angle at centre 2α: $\dfrac{2r\sin\alpha}{3\alpha}$ from centre

81. Solid cone or pyramid of height h: $\dfrac{1}{4}h$ above the base on the line from centre of base to vertex.

82. Conical shell of height h: $\frac{1}{3}h$ above the base on the line from centre of base to vertex

Moments of Inertia: For uniform bodies of mass m

83. Thin rod, length $2l$, about perpendicular axis through centre: $\frac{1}{3}ml^2$

84. Rectangular lamina about axis in plane bisecting edges of length $2l$: $\frac{1}{3}ml^2$

85. Thin rod, length $2l$, about perpendicular axis through end: $\frac{4}{3}ml^2$

86. Rectangular lamina about edge perpendicular to edges of length $2l$: $\frac{4}{3}ml^2$

87. Rectangular lamina, sides $2a$ and $2b$, about perpendicular axis through centre: $\frac{1}{3}m(a^2+b^2)$

88. Hoop or cylindrical shell of radius r about axis: mr^2

89. Hoop of radius r about a diameter: $\frac{1}{2}ml^2$

90. Disc or solid cylinder of radius r about axis: $\frac{1}{2}ml^2$

91. Disc of radius r about a diameter: $\frac{1}{4}ml^2$

92. Solid sphere, radius r, about diameter: $\frac{2}{5}ml^2$

93. Spherical shell of radius r about a diameter: $\frac{2}{3}ml^2$

94. Parallel axes theorem: $I_A = I_G + m(AG)^2$

95. Perpendicular axes theorem: $I_z = I_x + I_y$ (for a lamina in the x-y plane)

Universal law of gravitation

96. Force $= \frac{Gm_1m_2}{d^2}$

PROBABILITY & STATISTICS

Conditional probability

97. $P(A|B) = \frac{P(A|B)P(A)}{P(B|A)P(A) + P(B|A')P(A')}$

98. Bayes' Theorem: $P(A_j|B) = \frac{P(A_j)P(B|A_j)}{\Sigma P(A_i)P(B|A_i)}$

99. Standard discrete distribution

Distribution of X	$P(X = x)$	Mean	Variance
Binomial B(n,p)	$\binom{n}{x} p^x (1-p)^{n-x}$	np	$np(1-p)$

100. Standard continuous distributions

Distribution of X	P.D.F.	Mean	Variance
Uniform (Rectangular) on $[a,b]$	$\frac{1}{b-a}$	$\frac{1}{2}(a+b)$	$\frac{1}{12}(b-a)^2$
Normal N(μ,σ^2)	$\frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2}$	μ	σ^2

101. (i) Mean (m) of a population is given by

$$m = \frac{\Sigma fx}{\Sigma f} = c\frac{\Sigma tf}{\Sigma f} + k \quad where\ t = \frac{x - k}{c}$$

$$\text{Variance } (s^2) = \frac{\Sigma(x - m)^2}{N} = \frac{\Sigma x^2}{N} - \left(\frac{\Sigma x}{N}\right)^2$$

$$= \left[\frac{\Sigma x^2 f}{\Sigma f} - \left(\frac{\Sigma xf}{\Sigma f}\right)^2\right]$$

$$= c^2\left[\frac{\Sigma x^2 f}{\Sigma f} - \left(\frac{\Sigma xf}{\Sigma f}\right)^2\right]$$

$$\text{standard deviation} \quad s = \left[c^2\left(\frac{\Sigma t^2 f}{\Sigma f} - \left(\frac{\Sigma tf}{\Sigma f}\right)^2\right)\right]^{1/2}$$

(ii) (a) Discrete random variable X

$$\Sigma f_i = 1$$

$$\text{mean} = E(X) = \sum_{i=1}^{n} x_i f_i = \mu = \bar{x}$$

$$\text{Variance} = E\left[(x_i - \bar{x})\right]^2 = \sum_{i=1}^{n} f_i (x_i - \bar{x})^2$$

(b) Continuous random variable X

$$k\int_a^b \mathrm{f}(x)dx = 1$$

$$\text{mean} = E(X) = \mu = \int_a^b \mathrm{f}(x)dx$$

$$\text{Variance}(s^2) = \int_a^b (x-\mu)^2 \mathrm{f}(x)dx$$

$$= \int_a^b x^2 \mathrm{f}(x)dx - [\mu]^2$$

102. Kendall's Rank Correlation Coefficient (τ) = sum of number of agreements and disagreements about individual pairs between two rankings; (s)

$$\tau = \frac{agreements \ - \ disagreements}{\frac{1}{2}n(n-1)} = \frac{2s}{n(n \ - \ 1)}$$

103. Spearman's Rank Correlation Coefficient $\rho = 1 - \dfrac{6\,\Sigma\, D^2}{n(n^2 \ - \ 1)}$

104. The product moment correlation coefficient is

$$r = \frac{s_{xy}}{\sqrt{s_{xx}s_{yy}}} = \frac{\Sigma(x_i-\bar{x})(y_i-\bar{y})}{\sqrt{\{\Sigma(x_i-\bar{x})^2\}\{\Sigma(y_i-\bar{y})^2\}}} = \frac{\Sigma x_i y_i - \frac{(\Sigma x_i)(\Sigma y_i)}{n}}{\sqrt{\left(\Sigma x_i^2 - \frac{(\Sigma x_i)^2}{n}\right)\left(\Sigma y_i^2 - \frac{(\Sigma y_i)^2}{n}\right)}}$$

where s_{xy} = covariance of x and y

s_{xx} = variance of x

s_{yy} = variance of y

(b) Continuous random variable X

$$k\int_a^b f(x)dx = 1$$

$$\text{mean} = E(X) = \mu = \int_a^b f(x)dx$$

$$\text{Variance}(s^2) = \int_a^b (x-\mu)^2 f(x)dx$$

$$= \int_a^b x^2 f(x)dx - [\mu]^2$$

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$$r = \frac{s_{xy}}{\sqrt{s_{xx}s_{yy}}} = \frac{\Sigma(x_i-\bar{x})(y_i-\bar{y})}{\sqrt{\{\Sigma(x_i-\bar{x})^2\}\{\Sigma(y_i-\bar{y})^2\}}} = \frac{\Sigma x_i y_i - \frac{(\Sigma x_i)(\Sigma y_i)}{n}}{\sqrt{\left(\Sigma x_i^2 - \frac{(\Sigma x_i)^2}{n}\right)\left(\Sigma y_i^2 - \frac{(\Sigma y_i)^2}{n}\right)}}$$

where s_{xy} = covariance of x and y
s_{xx} = variance of x
s_{yy} = variance of y